ERCB

Daylight Energy Amalgamationco Ltd. Sour Gas Release Surface Location 06-23-047-10W5M December 16, 2009

ERCB Investigation Report

July 21, 2010

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Energy Resources Conservation Board

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1 Incident Overview

At 8:30 a.m. on December 16, 2009, Daylight Energy Amalgamationco Ltd. (Daylight) operators arrived at a lease to restart an oil well containing hydrogen sulphide (H_2S). The well, located at Legal Subdivision (LSD) 6, Section 23, Township 47, Range 10, West of the 5th Meridian (bottomhole location 11-23), is about 3.3 kilometres (km) southwest of the Town of Lodgepole. At 9:03 a.m., one of the operators started an electric heat tape assembly to heat the downhole tubing string of the well and then started the well.

At 9:47 a.m., the operators heard a loud bang from the well and upon investigation found that the well was leaking H_2S. It was not clear where the leak originated from, so an operator donned breathing apparatus and approached the well to investigate. It was concluded that the leak was coming from below the master valve but above the wellhead bonnet, and therefore they would be unable to stop the leak.

The lead operator on duty was immediately notified. He then notified the area foreman who activated the emergency response plan (ERP) at 9:55 a.m. At 9:58 a.m., the Energy Resources Conservation Board (ERCB) Drayton Valley Field Centre was notified. At this time, Daylight established its command posts: an on-site command post located at the perimeter of the 11-23 lease, an incident command post located at the Daylight Drayton Valley Field Office, and an emergency operations centre located at Daylight's Calgary office. In addition to the ERCB, Daylight notified Brazeau County, Alberta Health Services, Alberta Environment (AENV), and the local RCMP detachment.

The well has an H_2S concentration of 29.19 per cent, with a corresponding emergency planning zone (EPZ) of 570 metres (m). There are no permanent residents in the EPZ of the well; however, there is one registered trapline with two registered trappers. Daylight contacted one of the trappers during the incident, who confirmed not being in the area. Daylight was unable to contact the other trapper until after the incident was over. Daylight's ERP sets out a commitment made to a number of area stakeholders residing outside of the EPZ who requested to be contacted during any area emergency. Daylight initiated contact with these 31 residents at 1:18 p.m. and was able to contact 18 of them during the incident.

At 10:17 a.m., road blocks were set up north of the well at the intersection of Powerhouse Road and Highway 620 and south of the well on Powerhouse Road (see Figure 1, road blocks 1 and 2). At 12:53 p.m., after consultation with the ERCB, Highway 620 was closed from the west entrance of Lodgepole to the west side of the Powerhouse Road (see Figure 1, road blocks A and B). At this time, the entire 570 m EPZ had been isolated.

Between 10:30 a.m. and 11:00 a.m., Daylight dispatched three mobile air monitoring units (AMUs) to the site to monitor for H_2S. At 11:45 a.m., after reviewing the data collected by the AMUs, Daylight replaced one unit due to inaccurate readings and the ERCB AMU arrived on site. The mobile AMUs, including the ERCB's, remained in the area taking readings until the morning of December 17, 2009. In addition to the AMUs, Daylight operators used their handheld monitors to track H_2S levels along Powerhouse Road, Highway 620, and in Lodgepole.

By 11:10 a.m., Daylight had contacted service contractors to kill the well. By 3:00 p.m., the service contractor had arrived on site and commenced pumping water down the well casing. The release slowed quickly, and the well was completely dead by 3:24 p.m., after 3.5 cubic metres of water had been pumped.

At 3:28 p.m., after reviewing air monitoring data and in consultation with the ERCB, Daylight removed road blocks A and B and reopened Highway 620. Road blocks 1 and 2 remained in place, ensuring no unauthorized personnel could enter the well site. At 3:55 p.m., in consultation with the ERCB, the incident was officially called down by Daylight.

The incident was classified as a level-2 emergency using the ERCB's Assessment Matrix for Classifying Incidents and occurred in a rural wooded area. There were no injuries reported.

The incident received media attention, and a total of five press releases were issued during the incident: two by Daylight, two by the ERCB Communications Group, and one by Brazeau County.

1.1 History

The 11-23 well was originally drilled in May 2005. It was completed to the Nisku Formation and commenced production in December 2005. The most recent gas analysis of the well, taken April 1, 2009, indicated an H_2S content of 29.19 per cent. The well was prone to tubing hydrate formation during start-ups due to low temperatures, high pressures (~3000 kilopascals), high H_2S content, and the presence of water and hydrocarbons.

Because of these ongoing hydrate problems, a heat tape assembly was installed in the well on June 9, 2008 (see Figure 2). At that time, the well was owned by Highpine Energy Ltd. (Highpine). It was thought that the heat tape assembly would prevent any future hydrates from forming in the tubing. Highpine believed that a heat tape assembly would be more reliable for this well than a circulating heat string assembly. The circulating heat string assembly requires the use of a packer, which, to continue using the well's electric submersible pump, would have necessitated two additional electrical connections. These would reduce the reliability of the electrical system. The life expectancy of the heat tape assembly is typically two to three years. The heat tape assembly had been used on and off since its installation with no issues. Daylight has a similar heat tape assembly in its 11-11-48-10W5M (11-11) well. This system has been disabled since the incident at the 11-23 well.

Daylight acquired Highpine on October 8, 2009, and amalgamated to form Daylight Energy Amalgamationco Ltd., at which time Daylight assumed ownership of the 11-23 well. On November 13, 2009, Daylight submitted a proposed timeline for transferring the existing Highpine Lodgepole ERP to Daylight. This timeline was reviewed and subsequently approved by the Emergency Planning and Assessment (EPA) Section of the ERCB.

2 Significant Findings

2.1 Daylight Investigation

After the well was killed, Daylight observed damage to the heat tape assembly. There was visible damage to two of the three connectors in the connector assembly (see Figure 2, number 2), mostly on the centre connector. Additionally, one of the three wires and a section of the stainless steel tubing were missing from below the tubing hangar (see Figure 2, number 3). The heat tape was detached at the top of the bracket assembly (see Figure 2, number 6), and a gasket was pushing out of the surface junction box (see Figure 2, number 8). For photos of the damages, see Figure 3.

The triskelion (see Figure 2, number 1) and the connector assembly, along with the amperage chart history, shutdown history log, and event log history (all of which were downloaded

from the heat tape assembly drive), were sent to the manufacturer, Quick Connectors Inc. (QCI), for failure analysis.

QCI found that the failure was caused by excessive temperature created by a short circuit in one of the wires located in each connector. The outer two connectors did not show signs of excessive heat; however, the components in the centre connector were completely charred, indicating temperatures in excess of 500°F. The short was most likely above the connector assembly, directing the current from the outer two legs back through the grounded centre leg. This created a current overload and excessive heat.

The excessive heat of the short circuit destroyed the centre connector, allowing downhole gas pressure to push the wire located inside the connector to surface. This connector wire was found burnt off and wadded up in the surface junction box. The pressure was too high for the bracket assembly seal, and the seal ruptured. Gas was released from that seal, as well as the centre port at location 4 in Figure 2.

A heat tape inspection report (dated March 12, 2010) was also sent to QCI for review. The heat tape passed inspection, indicating that the short did not originate in the heat tape. Therefore, based on the location of the heat damage, Daylight believed that the short circuit occurred either in the connector assembly or in the wires between the connector assembly and the wellhead. Based on the heat-affected areas on the exterior and interior of the centre connector, Daylight believed this to be the most likely short circuit location.

The amperage chart on the day of the release showed that when the heat tape assembly was started, two of the three connectors were running at 120 amps, while the third never got above 22 amps. This rate continued for approximately one hour before the failure. The low amperage in the third connector also indicated that this was most likely the short circuit location.

Daylight and QCI agreed that a short circuit could be caused by contact with H2S gas leaking into the connector assembly and damaging the wires or by a blown or faulty fuse in the connector assembly. Because of the extensive heat damage to the interior of the centre connector (see Figure 4), neither Daylight nor QCI were able to conclusively determine the cause of the short circuit.

2.2 ERCB Investigation

The ERCB Investigation Team conducted a review of existing regulatory documents, other investigation reports, and information captured by field staff at the time of the incident. The Investigation Team has also fully reviewed Daylight's evaluation of the incident, including the third-party analysis and the technical explanation of the nature and circumstances of the blowout. The Investigation Team is satisfied with the failure analysis provided by Daylight and QCI. It is clear that a short circuit occurred in the centre penetrator, charring the interior of the connector and detaching the wire. Downhole pressure pushed the wire through the port on the wellhead, allowing H2S to leak through the resulting opening. The Investigation Team also accepts that due to extreme damage to the centre penetrator, QCI is unable to determine the exact cause of the short circuit.

Emergency Response

Throughout the incident, Daylight used the existing Highpine Lodgepole ERP to respond. During company mergers or takeovers, it is acceptable for a company to adopt the existing

ERP for the area until the new licensee creates its own ERP and submits it to the EPA Section for approval. As indicated previously, a timeline to transfer the Highpine ERP to Daylight was submitted to the EPA Section and approved. This was done in accordance with the requirements set out in *Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry*.

The ERP is compliant with *Directive 071*. There are no permanent residences or surface developments in the EPZ; however, there is one trapping licence (TPA 624) registered on the lands within EPZ. There are two holders listed on this trapping licence. Daylight was able to contact one holder of the trapping licence during the incident, but could not confirm that the other holder of the trapping licence was not in the EPZ. Contact with this individual was made after the incident was called down, at which time it was confirmed that this individual had not been in the EPZ. A transient search of the EPZ was not conducted and/or documented by Daylight.

Daylight's initial response involved setting up two road blocks north and south of the 6-23 well site and a third road block on the Bonterra Road to LSD 8-22-047-10W5M. These road blocks isolated all access to the EPZ. Roads within the EPZ, to Daylight 3-23-047-10W5M and Bonterra 4-23-047-10W5M, were checked for transient activity. Daylight continued to monitor the EPZ access roads throughout the emergency for transient, industry, and trapper activity. The ski trail on the east side of the EPZ was checked for evidence of vehicle, quad, and foot traffic. Roads surrounding the EPZ to the south, west, and east were also checked for vehicles and activity. No transient, industry, or trapper activity was documented by the responders performing rover duties during the emergency. As a result, Daylight was confident that sufficient actions were taken to clear and secure the EPZ. In addition, Daylight was continuously monitoring the wind direction and air quality in and around the EPZ, particularly the downwind outer north edge of the EPZ, to ensure that anyone potentially affected by the plume outside of the EPZ would also be protected.

The Investigation Team concludes that Daylight's response to the incident was appropriate. The Investigation Team also notes Daylight's attempts to adhere to commitments made in the ERP by its predecessor.

Air Monitoring

The Investigation Team finds that Daylight's air monitoring during the incident was conducted in a manner that provided a sufficient amount of information about the incident. The response time was satisfactory and the level of monitoring was protective of public safety. Monitoring activities during the incident were well organized, with Daylight and the ERCB working well together. Taking into account ambient condition changes and periods of low wind levels, the ERCB Investigation Team is satisfied that monitoring was conducted in a methodical and efficient manner.

The Investigation Team reviewed all air monitoring data submitted by Daylight. At the onset of the incident, concerns were raised by the ERCB regarding the validity of the data being gathered from one of the three AMUs, as it had not been calibrated properly. A replacement for this AMU was dispatched, and the Investigation Team is satisfied that data from the replacement unit are valid. In addition, the Investigation Team finds that the data from the other two AMUs dispatched by Daylight are acceptable, as sufficient levels of quality assurance and quality control measures were employed to demonstrate the validity of their data. In addition to data from the AMUs, Daylight provided data from the handheld monitors used by staff during the incident. The Investigation Team finds that proper quality assurance

measures were implemented with the handheld monitors, subsequently, the data can be deemed to be valid. Air monitoring conducted by the ERCB provided additional data support to Daylight.

Communication

All required agencies were contacted by Daylight at the onset of the incident (ERCB, AENV, Alberta Health Services, Brazeau County, and RCMP). Daylight maintained communication with and provided updates to all the parties throughout the incident.

The Investigation Team has determined that there were no contraventions of its regulatory requirements, but specifically noted the following areas for improvement.

- The ERP used by Daylight outlines processes to search for transients in an EPZ. In the future, Daylight should ensure that it conducts and documents searches of its EPZ if it suspects there could be transients present.
- Although Daylight's air monitoring was satisfactory, it could be improved by confirming that its air monitoring contractors have obtained and implemented all currently available quality assurance and quality control documents. This will ensure that the data they collect and provide are of the highest quality.

3 Actions Taken to Prevent Recurrence

3.1 By Daylight

The following is from Daylight's internal investigation report.

- Daylight has no plans to install or use a heat tape assembly in the future. The heat tape assembly located at the 11-11 well, although still functional, has been disabled, and the wellhead bonnet has been plugged to eliminate any possibility of a leak in the future.
- Daylight will ensure that all future electrical systems on any well, sweet or sour, will be approved subject to an engineering and safety review.
- Daylight will improve its ERP notification process for people outside of the EPZ during an emergency. Those not directly affected will be notified post-incident. Daylight will continue to work with the ERCB, AENV, the counties, Alberta Health Services, and other government and public agencies in its areas to ensure relationships are maintained.

3.2 By the ERCB

No actions are required of the ERCB.

4 ERCB-Directed Action

The ERCB directs that Daylight submit a safety alert to Enform within 60 days of the issuance of this report. This will ensure that knowledge relating to this incident is shared with industry, so that operators can take action to determine if any similar problems exist at their well locations.

5 ERCB Follow-up

- Staff from the EPA Section and the Law Branch will review the inclusion of nonregulatory commitments in ERPs submitted to the Board for review and approval, specifically, commitments made to contact residents located outside of the consultation and notification distances set out in *Directive 071*.

- Following the incident, the ERCB Community and Aboriginal Relations (CAR) Group in Drayton Valley tried to contact all local residents whom Daylight had attempted to contact during and immediately after the incident. Of those contacted, 27 provided addresses for CAR to send an incident follow-up letter. The letter asked whether the residents had been contacted by Daylight and whether they were satisfied with Daylight's response. To date, 12 responses from residents have been received by CAR staff; responses ranged from those who were satisfied with the response to those who were dissatisfied and requested further information. CAR is working with area residents on an ongoing basis.

- Drayton Valley CAR staff will ensure that all residents they previously contacted receive a copy of this investigation report once it is released.

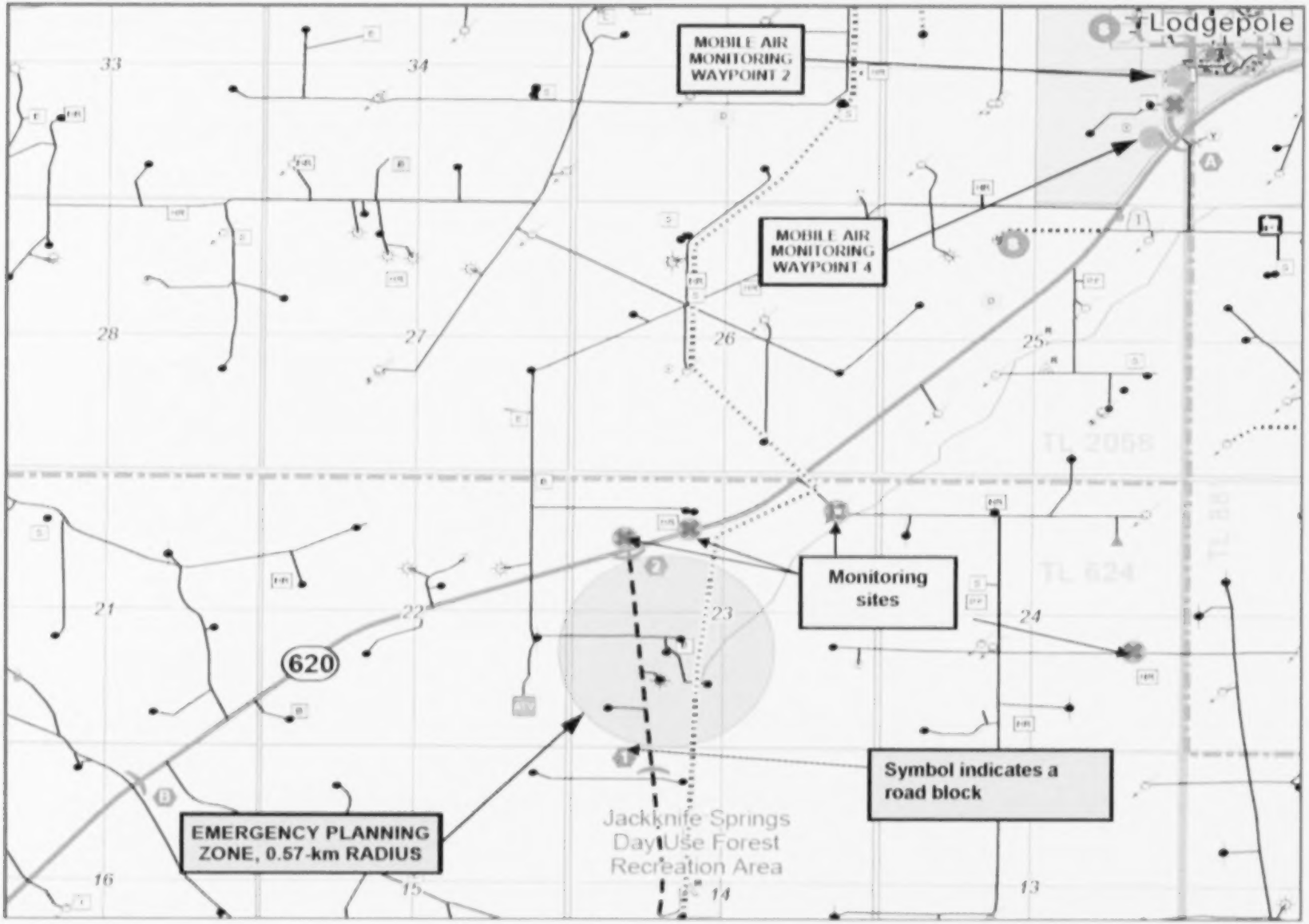
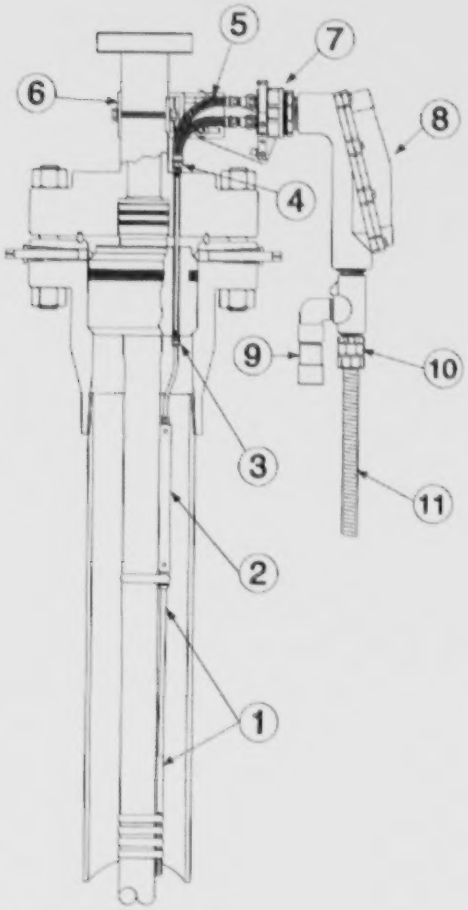
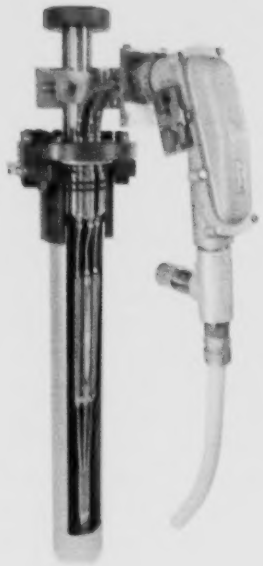


Figure 1. Area map





1. Triskelion
2. Connector assembly, made up of three connectors (failure point)
3. Bottom seal fitting
4. Top seal fitting (gas release point)
5. Flexible fitting
6. Bracket assembly (gas release point)
7. Three-inch union
8. Surface junction box
9. Detonation arrestor
10. Cable terminator fitting

Figure 2. Diagrams of heat tape assembly

Figure 3a. Cable assembly detached at top of bracket assembly

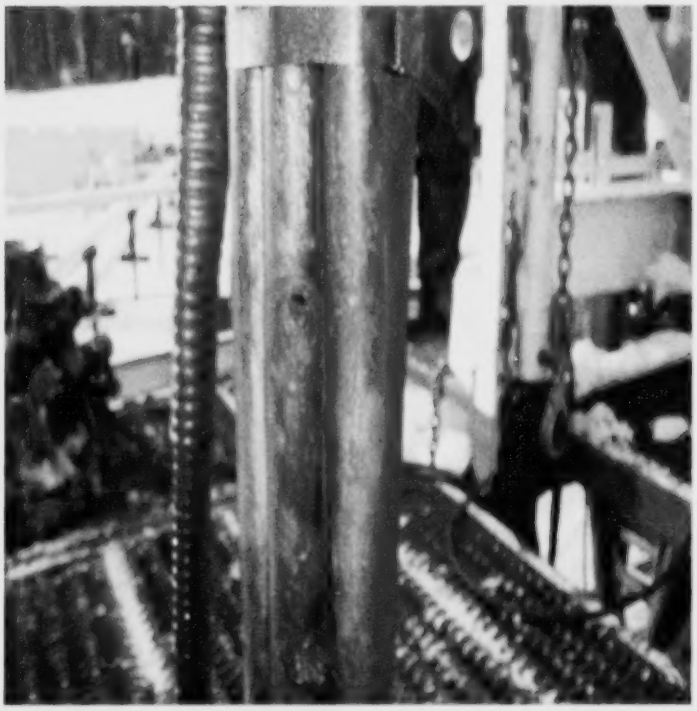


Figure 3b. External damage to connector assemblies

Figure 4. Comparison of damaged connector vs. undamaged connector